High-Resolution and Lightweight X-ray Optics for the X-Ray Surveyor

Completed Technology Project (2016 - 2018)

Project Introduction

Envisioned in "Enduring Quest, Daring Visions" and under study by NASA as a potential major mission for the 2020s, the X-ray Surveyor mission will likely impose three requirements on its optics: (1) high angular resolution: ~0.5" PSF, (2) large effective area: ≥10,000 cm2 or more, and (3) affordable production cost: ~$500M. We propose a technology that can meet these requirements by 2020. It will help the X-ray Surveyor secure the endorsement of the coming decadal survey and enable its implementation following WFIRST. The technology comprises four elements: (1) fabrication of lightweight single crystal silicon mirrors, (2) coating these mirrors with iridium to maximize effective area without figure degradation, (3) alignment and bonding of these mirrors to form meta-shells that will be integrated to make a mirror assembly, and (4) systems engineering to ensure that the mirror assembly meet all science performance and spaceflight environmental requirements. This approach grows out of our existing approach based on glass slumping. Using glass slumping technology, we have been able to routinely build and test mirror modules of ~10" half-power diameter (HPD). While comparable in HPD to XMM-Newton's electroformed nickel mirrors, these mirror modules are 10 times lighter. Likewise, while comparable in weight to Suzaku's epoxy-replicated aluminum foil mirrors, these modules have 10 times better HPD. These modules represent the current state of the art of lightweight X-ray optics. Although both successful and mature, the glass slumping technology has reached its limit and cannot achieve sub-arc second HPD. Therefore, we are pursuing the new approach based on polishing single crystal silicon. The new approach will enable the building and testing of mirror modules, called meta-shells, capable of 3" HPD by 2018 and 1" HPD by 2020, and has the potential to reach diffraction limits (~0.1") in the 2020s.

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Table of Contents

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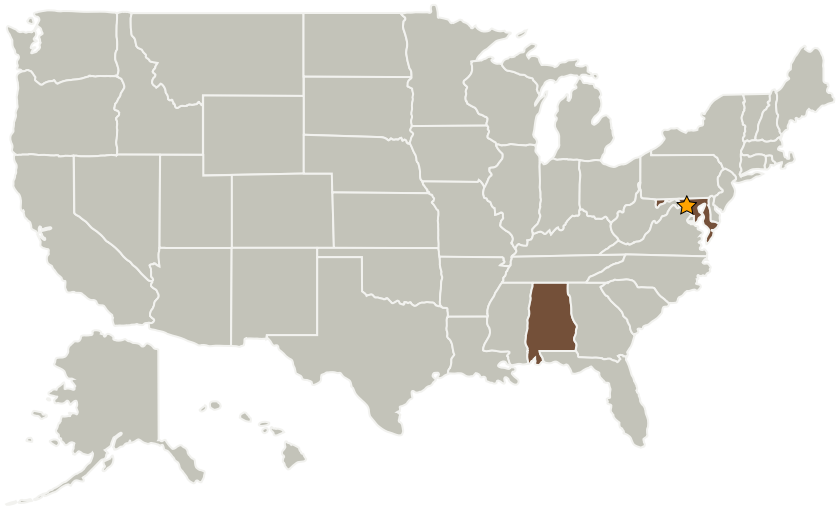
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Alabama	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Strategic Astrophysics Technology

Project Management

Program Director:

Mario R Perez

Program Manager:

Mario R Perez

Principal Investigator:

William W Zhang

Co-Investigators:

Raul E Riveros
Keith M Jahoda
Ryan S Mcclelland
Stephen L O'dell
Kai-wing Chan
Jessica A Gaskin

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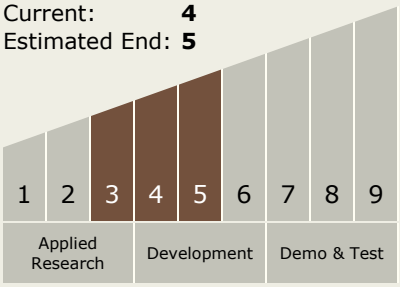
Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destination

Outside the Solar System